

# **NAVAL POSTGRADUATE SCHOOL**

## **Monterey, California**



## **THESIS**

**THE INFLUENCE OF DEMOGRAPHICS AND  
NAVY CAREER EXPERIENCES ON THE  
PERFORMANCE OF JUNIOR SURFACE  
NAVAL OFFICERS**

by

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March 1998

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EXPERIENCES ON THE PERFORMANCE OF JUNIOR SURFACE  
NAVAL OFFICERS**

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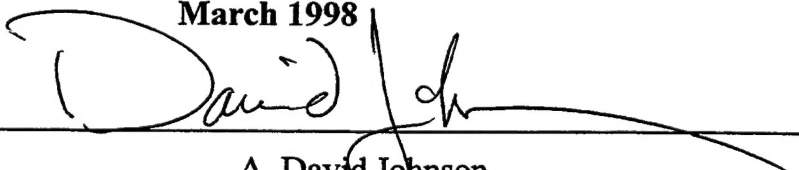
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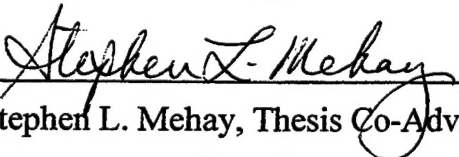
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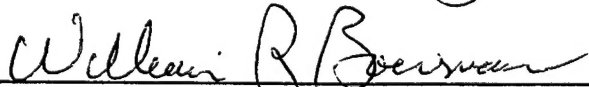
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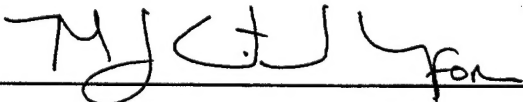
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## **ABSTRACT**

This thesis examines the relationship between pre-commissioning and post-commissioning characteristics and junior surface naval officer performance, retention, and promotion. The study uses data from the Officer Promotion History Files, (1981-1995). Data on 7,038 officers entering the Navy from 1976 to 1986 are analyzed. Results indicate that Naval Academy graduates, business majors, officers with CRUDES experience, and non-minority officers are more likely to achieve Surface Warfare qualification and receive top fitness report scores. NESEP and NROTC graduates, math majors, officers with CRUDES experience and top fitness reports, and minorities officers are more likely to stay in the Navy to the O4 promotion board. Academy graduates, engineering majors, officers with CRUDES experience, and officers with top fitness reports are more likely to promote to Lieutenant Commander. No significant difference is observed between minority and non-minority O4 promotion probabilities after pre-commissioning and post-commissioning factors are controlled. However, the effects of CRUDES experience, warfare qualification, and fitness report scores may lead to indirect effects which lead to observed performance and promotion rate differences between race/ethnic groups.



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## I. INTRODUCTION

Many factors influence the performance of junior surface naval officers, including pre-commission education background, commissioning source, and initial assignment.

The opportunities an individual has to shape his or her Navy career vary depending on the unique circumstances and experiences of the individual's past as well as performance after commissioning. That is to say, every situation is different and the degree to which a junior surface naval officer can influence future assignment and promotion potential depends on past experiences as well as current performance.

Sometimes the junior officer (JO), or more specifically, the junior surface naval officer, has little or no control over certain characteristics which affect performance potential. For example, several studies have found minority status and gender to be statistically significant factors in explaining one's potential for success as a naval officer, yet nothing can be done to change one's ethnicity, and changing one's gender to increase promotion potential would no doubt lead to a discharge instead of a promotion.

Still, there are many things junior surface officers do control, or can influence to improve their career prospects. For example, college GPA is linked to initial ship assignment. In general, junior officers with higher college GPA's enjoy greater success at receiving orders to more desirable billets. Naval Academy graduates are afforded the opportunity to select their initial assignment, and the selection process is based on college GPA. Undergraduate grade point average affects non-Academy graduates as well;

accessions from Naval Reserve Officers Training Corps Units receive rankings from their Commanding Officers which are influenced by GPA, among other things.

The significance of initial ship assignment cannot be over-looked. Certain ship classes have been found to contribute to a junior surface officer's performance potential by affording greater opportunities to pursue surface warfare qualifications, and the advantage of experience in battle group operations (Bellamy, 1991). Additionally, initial ship assignment may affect following ship assignments. Experience in a ship type may encourage officers to request similar platforms for follow-on assignment. Also, background in ship specific systems may influence detailers, who are responsible for matching personnel to ships. For example, the junior surface officer with Division Officer experience in engineering systems on ships equipped with gas turbine main propulsion engines may be more likely to receive a follow-on assignment as an Engineering Officer aboard another gas turbine equipped ship.

Another important performance factor that a junior officer can influence is Fitness Report (FITREP) scores. Job performance and attitude are of high interest to the JO's chain-of-command in grading FITREP scores, and the difficulty level of one's assigned billet has much to do with both. Historically, assignments such as Boilers Officer, Damage Control Assistant, First Lieutenant, and Auxiliaries Officer on ships are considered the most demanding junior officer billets due to arduous working conditions and immense administrative requirements (Bellamy, 1991). Assignment to one of these

demanding billets may become a factor in performance scores as officers filling these billets are evaluated along with others filling less demanding assignments.

Fitness Report grading criteria is based on a variety of inputs. FITREP's provide an opportunity for Commanding Officers to evaluate their officer's past performance, both objectively and subjectively, in order to assess the potential of junior officers individually and against their peers. The junior surface warfare officer who excels at his or her job, maintains a good attitude, and shows promising potential will generally fare well on the FITREP.

Still, in the competitive environment of the surface officer community, the ability to control one's future by pursuing advantages and avoiding pitfalls is of great interest to the junior officer. Knowledge of significant performance factors, both positive and negative, may greatly enhance a JO's competency and lead to increased retention and promotion potential. Ideally, junior naval officers would have perfect information and freedom to pursue their careers as vigorously as they wished. Barriers to success would be only the products of their own making and the results of past decisions. But, this is not always the case. No one, not even the board member who makes promotion and retention decisions, has perfect information. Not to mention, promotion opportunity is based on vacancies at the next higher grade, a condition which is completely out of the control of promotion candidates.

## **A. STATEMENT OF THE PROBLEM**

Junior surface naval officers are among the hardest working personnel in the fleet. To remain competitive for promotion and ultimately pursue a career as a naval officer, the junior officer must reach a series of milestones designed to help develop him or her into a productive and proficient leader. The JO qualification process is designed to provide a foundation upon which the aspiring junior officer can build as he or she pursues what many consider the apex of a surface naval career, command-at-sea.

The degree to which the junior officer is prepared to meet future challenges depends largely on the available opportunities for meeting qualification milestones. In the fast-paced, highly competitive environment of today's naval officer's corps opportunities may come only once, and advantages gained by being at the right place at the right time may set one officer up for success while a less fortunate peer must work harder to survive.

### **1. Career Track**

Generally, the newly commissioned surface naval officer attends a sixteen week Surface Warfare Officers School (SWOS) indoctrination course in Newport, R.I. where the basics of many shipboard systems, programs, and operations are taught. Following SWOS the surface officer may attend any of a number of specialty schools as preparation for a particular billet, or job assignment. But, eventually (usually within about six months of commissioning), the young JO meets his or her first ship.

Although the new officer has just completed several months of general training, specific skills must be developed. This is usually accomplished by participating as an 'under-instruction' watch stander until the requisite level of proficiency is reached. Before crew members can contribute in a meaningful way, they must qualify at any of a number of duties and watch stations. From basic damage control to general quarters watch stations, JO's will spend the next two to three years pursuing professional qualifications while running the day-to-day operations of their divisions. The amount of time JO's have to devote to qualification depends on many things: the ship's schedule, equipment status, personnel issues, and daily workload demands, to name a few. But the young JO must qualify, and sooner is always better than later since demands on time increase with seniority.

For the junior officer, the qualification process is never ending. Surface naval officers are expected to continue to develop professionally even after meeting initial JO qualification milestones. Following the Division Officer tour(s) one is expected to pursue more advanced qualifications. Tactical Actions Officer (TAO) and Engineering Officer of the Watch (EOOW) qualifications must be completed during the Department Head tour(s) if not done previously. There are a variety of qualification opportunities and the career-minded individual is wise to show a continuous effort in the pursuit of professional excellence.

## **2. First Assignment**

Although some JO's (prior enlisted and NESEP graduates for example) may have already served on a similar platform before, for the majority of these officers this is their first assignment as part of the regular crew. The JO usually has little time to ease into the new job and the previously addressed demands to "get qualified" must be confronted on a daily basis. Also mentioned earlier, platform type may play a significant role in the JO's ability to qualify quickly, or even on time. Some platforms have more of the weapon systems and are more involved in the kinds of operations with which a JO must become proficient to earn surface warfare officer (SWO) qualification. In general, CRUDES ships for surface JO's are considered to be platforms which offer the greatest opportunity for warfare qualification (Bellamy 1991).

The billet, or job assignment, a JO fills on the platform also may be important. Billet assignment plays a role in the amount of time that can be devoted to qualifying. Assignment to platforms or billets outside of those most conducive to success does not relieve the JO of the requirements of qualification, it simply makes the process more difficult. But, regardless of ship and billet assignment, the most important element in the pursuit of a successful career in the Surface Navy is still good performance in whatever ship or billet assigned. Poor performance in a career enhancing billet does little to impress one's Commanding Officer or promotion board members.



## **B. SCOPE AND FOCUS**

This thesis seeks to analyze the career paths and measures of success for surface officers, specifically,

- (1) What factors influence junior surface naval officer performance?
- (2) What factors influence junior naval officer retention?
- (3) What factors influence junior surface naval officer promotion to Lieutenant Commander?
- (4) What is the effect of minority status on junior surface naval officer performance, retention, and promotion to Lieutenant Commander?

The degree to which demographics influence junior surface naval officer performance is a matter of debate in many circles. This thesis focuses on the relationships between several demographic characteristics and performance measures and seeks to estimate the degree to which each characteristic influences performance, retention, and promotion. To that end, this thesis attempts to decompose the portion of performance differences between minorities and non-minorities that are due to: (a) pre-commissioning factors; (b) Navy career experiences (jobs, ship type), and (c) other. In so doing, the goal is to distinguish what portion of career success can be attributed to pre-commissioning factors (such as GPA), what portion can be attributed to one's early career path, and what portion remains unexplained. When this decomposition is conducted for minority and non-minority groups the remaining unexplained portion may be due to factors associated with race or ethnicity.

### **C. BENEFITS**

The reader has only to look at the daily paper to find examples of racial and gender discrimination in both the public and private sectors. As a cross section of society, the military has not been spared some of the same problems, prompting policy makers and analysts to evaluate existing policies and explore alternatives with the goal of eliminating practices and opportunities which may result in the differential treatment of minorities. But, we must be careful not to over react or look for easy answers to complex problems. Rarely are the answers to deep-rooted social problems simple ones. If they were, we would have found them long ago. Instead, we must look to trends and explore indirect effects to decompose the problem into its elements so that they can be addressed individually and in the most effective manner.

The potential benefits of this research are significant and far-reaching. Besides the obvious importance of equal opportunity for minority and non-minority officers in the surface warfare community, this study further focuses attention on the significance of undergraduate degree choice, college GPA, and early career experiences to help separate direct effects of demographic characteristics and career experiences from the indirect effects of race or ethnicity.

Far too often the research conducted in this area fails to look deeply enough into significant demographic and experience characteristics to properly decompose them. Simple frequency analysis fails to capture the combined and indirect effects of characteristics which may influence a particular outcome. For example, if assignment to

a preferred ship type and high GPA are correlated, then it may be that officers assigned to these platforms are more highly motivated or possess greater adaptability to navy life than their counterparts who choose or are assigned to less preferred units. Or, if minority status and promotion rates are correlated, it may be that early career experiences and pre-commissioning education choices explain the disparity.

Notwithstanding, discrimination is an ugly and ever-present reality in our society. This thesis is not prepared to address the causes or implications of pre-commissioning discrimination, but is limited to the study of the influence race and ethnicity may have in determining retention and promotion outcomes for junior surface warfare officers. But, having said that, minority/non-minority promotion rate difference is not the primary focus of this study. This study focuses on the decomposition of several variables to determine the separate effects of pre-commissioning education and early career experiences for all junior surface warfare officers. The study then explores the degree to which minority status may play a role in measured performance differences.



## **II. LITERATURE REVIEW**

Many factors affect a junior surface warfare officer's probability for retention and promotion. Estimating junior officer retention and promotion probability has been studied for several years and considerable literature is available on the topic. This study draws from past literature and highlights items of particular interest. The purpose of this chapter is to provide a review of past studies and acquaint the reader with the works of others should he or she wish to explore the topic further.

This study groups commissioning source (SOURCE) into five broad categories: U.S. Naval Academy (USNA), Naval ROTC scholarship program (NROTC\_S), Naval ROTC college program (NROTC\_C), Officer Candidate School (OCS), and Navy Enlisted Science and Engineering Program (NESEP). Each commissioning source category possesses enough unique characteristics to distinguish it from the other categories. The degree to which each may affect officer performance, retention, and promotion has been studied extensively and trends emerge which cannot be overlooked. Most notably is the effect of the variable USNA on all measures of junior naval officer performance, including ship assignment, fitness report scores, and promotion.

### **A. OFFICER PERFORMANCE STUDIES**

This study examines junior surface naval officer performance as measured by fitness report (FITREP) scores during a individual's first ten years of commissioned service; that is, from commissioning to O4 promotion board screening. Several prior

studies have also used fitness report information to measure office performance. Using OLS regression Mehay (1995) found that USNA graduates, females, and married persons, or those with dependents, receive better evaluations, on average, than their peers. He also found that minorities tend to receive significantly lower FITREP scores than non-minorities, all else equal.

Pre-commissioning education experiences lay the foundation upon which a surface warfare officer's career will be built. They are influential in initial ship assignment and job specification (billet) which has been shown to be significant in warfare qualification results. While commissioning source category has been shown to be statistically significant in predicting future performance, it is difficult to analyze the degree to which the commissioning source itself actually makes the difference. College entry requirements (SAT/ACT) and self selection into a particular commissioning source category (USNA, NROTC, OCS, NESEP) may be indirectly responsible for some of the observed performance variation. That is to say, individuals who attend the U.S. Naval Academy may possess a stronger desire for military life than those who enter the naval service through other commissioning programs (Mehay 1995). And, the self-selection of individuals with high GPA's into career enhancing assignments may lead to measurable differences in future performance. Or, in other words, college choice may be associated with one's desire and motivation to become a successful career surface naval officer and not simply with the quality of education provided. Performance while in college may

then afford individuals with higher GPA's the opportunity to choose career enhancing ship assignments.

Notwithstanding, the quality of education provided at any institution plays a significant role in preparing graduates for success in the work place. In many cases a persons occupational and career choices are not related to their college degree. Nowhere is this more the case than in the military. The military accesses officers from all backgrounds and undergraduate educational experiences. Though some degrees lend themselves to specific job assignments, most do not and it is the quality of a persons educational experience more than the subject of his or her studies that helps predict future performance. It is for this reason that this study incorporates allowance for college selectivity. Barron's Profiles of American Colleges, an index of college selectivity, is used in this study along with the commissioning source variables NROTC and OCS to create variables to isolate the effects associated with the quality of education. College selectivity is expected to act much like GPA, leading to generally higher performance ratings for graduates of more selective colleges and universities.

## **B. OFFICER RETENTION STUDIES**

Commissioning source, undergraduate education, Navy experience, and minority status are shown to affect officer retention. Mehay (1995) found that graduation from USNA is a significant predictor of junior officer retention to the Lieutenant Commander (O-4) board when compared with other commissioning sources. Mehay and Bowman (1997) suggest one possible explanation for USNA graduate success is the nature of

training at the Naval Academy which may increase an individual's stock of firm-specific human capital, as compared to other commissioning sources.

But, exceptions may exist in certain cases. USNA graduates with initial assignment to aircraft carriers tend to leave the Navy at a higher rate (59.7 percent) than either NROTC (51.6 percent) or OCS (42.4 percent) graduates, regardless of GPA (Bautista, 1996). However, though GPA is not a significant factor in aircraft carrier (CV/CVN) attrition, it is significant in initial ship assignment, and the indirect effect of grades on ship type may explain attrition rate differences. That is to say that, on average, USNA graduates assigned to aircraft carriers as an initial sea tour have lower grades and possibly a lower propensity for naval careers than their peers from other commissioning sources.

The influence of initial ship type is not limited to aircraft carrier assignment for USNA graduates. Initial ship type assignment appears to affect the decisions of whether or not to stay in the Navy for a broad range of surface naval officers. Retention rate differences are found which appear to be related to ship type regardless of minority status or seniority, with aircraft carrier assignment leading to the highest attrition rate for all categories (Bautista, 1996). The Bautista study provides a convincing argument that retention and ship type may be correlated, and in many cases quite strongly.

However, separation rates of junior surface naval officers based on ship type does not necessarily mean that any disadvantage exists between assignment to CRUDES (lower attrition rates) and aircraft carriers (higher attrition rates). As mentioned earlier,



initial ship assignment is correlated with undergraduate education performance, and the lower attrition rates of CRUDES ships may be related by the indirect effect of greater job satisfaction experienced by junior surface naval officers assigned to those platforms. Though the data do not offer the opportunity to isolate junior officer ship preferences, it would seem logical that officers desiring assignment to aircraft carriers and amphibious ships would experience the same job satisfaction and performance as their CRUDES counterparts.

In a study of 1,560 Naval Academy graduates from 1976-1980 Bowman (1990) finds that, in general, officer attrition is not related to academic major or GPA. He suggests that retention decisions are based on early career experiences and perceived monetary options near the end of one's service obligation. These findings do not contradict other studies which find pre-commissioning educational experiences to have a significant effect on retention since Bowman's study focuses on USNA graduates, who experience lower overall attrition rates anyway.

### **C. OFFICER PROMOTION STUDIES**

Many factors combine to affect an individual's promotion probability. Mehay (1995) found that USNA graduates tend to receive better evaluations than their non-Academy peers, and that early fitness reports appear to be a strongly related to surface warfare officer promotion rates. This finding is consistent with observed promotion rate differences between commissioning source variables in several other studies.

Another important promotion factor is warfare qualification. Timely surface warfare qualification is, understandably, an important milestone in a junior surface naval officer's career. Failure to achieve this important distinction will invariably have adverse effects on a JO's promotion prospects. Initial ship assignment has been shown to have a significant effect on the timeliness of surface warfare qualification (Bellamy 1991). To complicate matters further, warfare qualification opportunities may vary with ship type. As mentioned earlier, CRUDES ships may offer the greatest opportunity for surface warfare qualification due to the nature of their operations and the array of combat systems installed.

Several other variables, such as undergraduate major, GPA, and age may influence promotion indirectly and will be discussed later as direct effects and indirect effects are decomposed using multivariate modeling techniques. Suffice it to say here that many characteristics of demographics and early Navy career experiences influence promotion probability either directly or indirectly.

#### **D. STUDIES OF MINORITY OFFICERS**

An important goal of this thesis is to analyze the effects of minority status on junior surface naval officer performance, retention, and promotion probability. The further decomposition of significant variables into direct and indirect effects will help identify underlying causes of the observed disparity in performance and promotion rates for minority junior naval officers.

Mehay (1995) finds that most of the performance and promotion rate differences between minority and non-minority junior naval officers can be traced to the indirect effects of pre-commissioning education and early post-commissioning experience factors. However, when GPA and ship type are included in non-linear regression models, to control for their indirect effects on minority officer performance, a significant unexplained disparity still remains and is cause for concern.

Interestingly, though most studies find minorities to be at a disadvantage with respect to promotion rate, many find that minority junior officers enjoy a higher retention rate than do non-minority officers. With the exception of officers who's initial ship assignment was on amphibious type ships, black junior surface naval officers experience higher retention rates than white officers (Bautista, 1996). Application of the ACOL model may suggest that a real, or perceived, dearth of opportunity for minority officers in the private sector influences their decision to stay on the Navy.



### **III. METHODOLOGY**

#### **A. OVERVIEW**

This chapter describes the data used in this study as well as the methodology used to analyze those data. A description of variables and specifications of the model will be discussed to clarify the scope of the study, followed by an explanation of why these variables and estimation techniques are employed.

#### **B. DATA**

Two data sets are used in this thesis. The first data set contains over 24,000 observations and provides pre-commissioning and post-commissioning characteristics of Navy unrestricted line officers, including demographics, educational background, and Navy performance. The second data set contains detailed information on ship and billet assignments for surface warfare officers (SWO). Both data sets were derived from the Navy's Officer Promotion History Files. The two data sets were matched and merged to create one file containing 9,921 observations and 183 variables. Additional variables were created from the original files to better isolate characteristics and experiences of interest to this study.

This study focuses on the SWO community and on those variables predicted to have the greatest effect on SWO performance, promotion, and retention potential. Restrictions were placed on the data file to include only individuals who were in the surface warfare officer community at the Lieutenant/O3 promotion board. It is

recognized that this restriction could be a problem if an individual were to change communities after the O3 promotion board screening. But this restriction is necessary in order to focus on a group of officers who may be considered "careerists" in the Surface Warfare Officer community.

The resulting SWO subset of the data file contains 9,882 observations and over 123 variables. But, due to missing observations for some variables, the usable data set is further reduced in size to 7,038 observations for the performance and retention models. Specifically, missing values for college grades and college selectivity reduces the data set to 8,305, and missing observations in the officer fitness report variables caused the further reduction to 7,038. Promotion models were run on 3,742 observations since individuals must first satisfy the condition of staying to the O4 promotion board if they are to be considered for promotion.

The variables used in this study can be divided into two broad groups: (1) pre-commissioning factors, and (2) post-commissioning factors. The first group, pre-commissioning factors, contains variables which categorize demographics, education, and commissioning source; the post-commissioning factors include variables which define performance, ship assignment, retention, and promotion.

### **C. VARIABLE DESCRIPTION**

Eleven variables were chosen for the binary LOGIT models. Some of these variables are used as both independent and dependent variables depending on the specific model. Independent variables include both pre-commissioning and post-commissioning

factors, and demographics such as Ethnicity (minority/non-minority), Marital Status (MARRIEDL is married at time of the O3 promotion board, and MARRIEDH captures one's marital status at the time of the O4 promotion board), Age (at time of commissioning), and Prior Enlisted Service (two or more years of prior enlisted service).

In addition, we also use information related to undergraduate college experience including, Major (field of study: bio-physical sciences, math/computer sciences/OA, engineering, social sciences, business/economics, and humanities/NEC), Grade Point Average (GPA derived from academic profile code); and Commissioning Source. The latter is composed of USNA, NROTC, OCS, and NESEP graduates. NROTC and OCS variables are then combined with Barron's Profiles of American Colleges to produce interaction terms for ROTC\_HI, ROTC\_LO, OCS\_HI, and OCS\_LO, where "HI" and "LO" refer to high selectivity (top three categories) and low selectivity (bottom three categories), respectively.

Post-commissioning factors include fitness report (FITREP) scores at two points in a surface naval officer's career; TOPFIT12 which refers to whether or not an officer received FITREP's recommending early promotion more than 75 percent of the time during the grades of O1 (ENS) and O2 (LTJG), and TOPFIT3 which measures the same response for the grade of O3 (LT). Second, we also know each person's ship assignment, which simply refers to whether or not an individual has been assigned to a Cruiser, Destroyer, or Frigate (CRUDES) at any time after commissioning; the variable CGEXP is created to define this ship assignment experience, where CGEXP=1 if an individual has

CRUDES experience and CGEXP=0 if the individual doesn't. YR2SWOQL measures an individual's success at achieving the SWO qualification within two years of commissioning. Finally, two additional dependent variables are analyzed in the study: (1) retention (LCSTAY), that measures retention to the Lieutenant Commander Selection Board, and (2) promotion, (PROMO4) that indicates if an officer was promoted to O4.

#### **D. VARIABLE EXPLANATION**

##### **1. Independent Variables**

###### **a. Pre-Commissioning Variables**

The influence of minority status is important in this study. The original 'ethnic' variable was decomposed by combining all non-white observations into one group and all white observations into the other to create the variables NONWHT and WHITE, respectively. A binary variable for non-white (NONWHT) is used to isolate differences in performance measures between minorities and non-minorities. Though at first sight it would appear that considerable promotion rate disparity exists between race/ethnic categories, much of the difference in performance may be traced to the effect of pre-commissioning education choices and opportunities rather than any systematic practice of institutional discrimination. A primary goal of this research is to determine what portion of junior surface officer performance and promotion rate differences can be traced to legitimate pre-commissioning and early career experience factors, and what portion remains unexplained. That is not to say that unexplained differences in performance, retention or promotion rates are necessarily the product of unfair or unequal treatment, it



may simply be that the model fails to capture all relevant factors (observed and non-observed) that explained performance and promotion.

The original 'marital status' variable describes several variations of dependent status (single, married, one child, two children, etc). But, the number of dependents proved to be insignificant for the purposes of this research so new variables 'married' and 'single' were created by grouping the others to simplify the model specification; MARRIEDL refers to individuals who were married at the time of the O3 (LT) promotion screening board, and MARRIEDH refers to those who were married at the time of the O4 (LCDR) promotion screening board.

A variable for age is included to observe the effects of this characteristic. Age is generally considered to be measure of maturity and stability, and is expected to be significant in retention, and promotion models. Human capital research finds age to be significant in retention and promotion models for many civilian occupations. This research suggests that older employees are more averse to changing occupations than their younger colleagues, and are therefore more likely to retain and promote within the organization. This aversion may be caused be a perception that older individuals have fewer job opportunities, or that with age and maturity comes commitment.

But, the Navy officer recruiting system and the 'grow your own' promotion process restricts the distribution of age-at-time-of-commissioning to a fairly narrow range between roughly twenty-two and twenty-six, which in turn leads to corresponding age groupings at the Lieutenant Commander promotion boards. However,

exceptions may exist when considering prior enlisted and some OCS accessions who are generally older at time of commissioning than Naval Academy and NROTC graduates. It is expected that variation in the variable 'age' will be sufficient to warrant its use in both retention and O4 promotion board models.

A variable for prior enlisted service (PRENL2YR) is included as a measure of the extent of pre-commission employer-specific experience. This variable measures whether or not a junior naval officer has a minimum of two years prior enlisted service. Commissioned officers with prior service are generally more informed and aware of what lies ahead in their naval careers than their 'non-prior' shipmates. Organizational management theory suggests realistic job previews to be an important contributor to job satisfaction and retention. Prior enlisted service should provide this realistic job preview and help the prospective junior naval officer make more informed career choices. Having previous service may also mean that the junior officer is older at time of commissioning and at the O4 promotion board.

The prospective naval officer must make choices that may influence performance and promotion potential long before commissioning, and in most cases even before the individual is aware of the possible future impacts of those choices. Undergraduate degree and commissioning source are two factors which prove to be significant in many military manpower performance models. Undergraduate grade point average (GPA) is often a significant indicator of future performance as well.

With respect to undergraduate degree choices, Officer Candidates and Midshipmen have a range of choices from humanities to engineering. Some individuals may be subject to degree choice constraints due to college entrance test results (SAT/ACT) or by pre-college educational background. But, nonetheless, those limitations are often a result of choices made in the past and for the purpose of this study are considered pre-commissioning choices. In an atmosphere of increasing technological complexity it would seem logical that undergraduate degree programs which emphasize technical curricula would better prepare the junior naval officer for the challenges of modern warfare. Intuitively, degrees in engineering, math, and physical sciences would improve a junior officer's chances for superior performance and promotion, while one would expect degrees in non-technical fields, like business, humanities, and social sciences, to hinder junior naval officer performance.

The effect of grade point average (GPA) on performance also expected to be positive, irrespective of degree choice. Though GPA and degree choice must be weighed together, since technical degrees are generally considered more challenging than non-technical degrees, a high GPA in any field of study is a mark of superior performance and cannot be discounted due to degree type. However, all else being equal, high GPA's in technical fields would seem to be the best predictor of superior performance and promotion potential when considering undergraduate education choices.

The final pre-commissioning choice for the future naval officer which this research considers is commissioning source. The prospective naval officer has several

options from which to choose. This study looks at five basic options: U.S. Naval Academy (USNA), Naval Reserve Officers Training Corps (NROTC) scholarship or college program, Officer Candidate School (OCS), and the Navy Enlisted Science and Engineering Program (NESEP). Three of these programs are funded (USNA, NROTC scholarship, and NESEP) while OCS and NROTC College Program are unfunded.<sup>1</sup> Individuals attending funded programs bear little or none of the direct cost of education. In most cases though, qualification for funded programs is highly competitive and qualification for these programs depends largely on pre-college education performance. NESEP students are prior enlisted individuals who seek a commission and participate in this program to complete a required engineering or science bachelor degree.

Unfunded commissioning programs include OCS and the NROTC College Program. Most OCS graduates complete their college degrees at their own expense before incurring any military obligation. NROTC College Program students may receive assistance with text book expenses but bear the cost of tuition themselves. Also, NROTC College Program students may apply for scholarship and gain assistance from the Navy for their remaining college expenses.

#### **b. Post-Commissioning Variables**

Post-commissioning performance variables include time to warfare qualification (YR2SWOQL), fitness report scores (TOPFIT12, TOPFIT3), and ship

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<sup>1</sup> Approximately 24 percent of SWO OCS accessions are prior enlisted individuals, who may have received tuition assistance from the Navy. Also, 66 percent of all prior enlisted SWO's are commissioned via the OCS program.

assignment (CGEXP). The timely attainment of surface warfare qualification is expected to be a significant factor in surface naval officer performance and promotion models. Generally, surface naval officers are given two years from the time they report aboard their first ship to achieve warfare qualification. Failure to meet this career milestone may result in an adverse fitness report evaluation which could hinder the individual's prospects for future promotion.

Two warfare qualification variables are used in this study. A continuous variable (YRSWOPIN) which measures how long it takes an individual to get Surface Warfare Officer (SWO) qualified is included and has a range of one year to eight years. A second, dichotomous, variable (YR2SWOQL) is used to identify the effects of qualifying within two years of commissioning<sup>2</sup> and takes on the value of zero (0) for 'did not qualify within two years' and one (1) for 'qualified within two years'. Due to the importance of this career milestone timely qualification is expected to be significant in explaining junior officer performance and promotion outcomes.

Fitness reports are part of an officer's permanent record and are used as a selection and screening tool at promotion boards. The variables associated with FITREP's are expected to be significant in promotion models. FITREP scores generally serve as measures of productivity and performance related to innate ability and cognitive skills. Due to the subjective nature of fitness reports, it is here that a junior officer's

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<sup>2</sup> No measure is available in the data file to indicate time to SWO qualification relative to ship assignment. The SWO qualification variable (YR2SWOQL) used indicates qualification status after two years of commissioning date, and may be a measure of superior performance if YR2SWOQL=1.

personality and motivation may influence the individual's opportunity for promotion. For this reason, FITREP scores are included to capture the typically "non-observed" motivation factors excluded in most empirical studies. Disparity in fitness report scores between individuals or groups may indicate attitudinal and personality differences as much as professional capabilities.

CRUDES ships are considered the backbone of the fleet. These small and medium size combatants carry more of the weapon systems and are involved in more of the kinds of operations that define surface warfare than most other ship types. It is no surprise then that officers assigned to these platforms tend to achieve warfare qualification more rapidly than their peers. From a human capital standpoint, the duties and responsibilities associated with CRUDES experiences increase the value of junior naval officers at a greater rate than other ship types, and therefore one would expect it to be positively related to junior naval officer performance and promotion.

## **2. Dependent Variables**

### **a. Pre-Commissioning Variables**

This thesis focuses on characteristics which affect junior surface officer post-commissioning performance. No pre-commissioning variables are used as regressands. However, some post-commissioning variables which were discussed above are used as dependent variables and will be addressed below as they serve as both regressors and regressands depending on the estimated model.

## **b. Post-Commissioning Variables**

The performance measures TOPFIT12, TOPFIT3, YR2SWOQL, and CGEXP previously discussed as independent variables are also used as dependent variables. Identifying the characteristics which influence performance measures will aid in understanding of why these factors are (or are not) important in retention and promotion outcomes. It is from the analysis of these models that we may test hypotheses with respect to indirect effects of demographics and pre-commissioning education.

Retention and promotion are the two primary dependent variables used in this study. Both are measured at Lieutenant Commander promotion board and have the greatest policy implications. Retention to the Lieutenant Commander promotion board is, of course, a prerequisite for promotion to Lieutenant Commander. But, just as importantly, it is also a measure of career motivation and can stand alone as an important variable in this study. The fact that it usually comes at the mid-point in an officer's potential career obligation makes it a natural indicator of career intentions. Attrition at this level is costly to the Navy, which is one reason this variable is often included in naval officer analyses.

Promotion to Lieutenant Commander is the apex of this study. Everything up to this is used to measure the probability of a SWO reaching this career milestone. Promotion to Lieutenant Commander is a good indicator of career intention for surface warfare officers. This career milestone is usually reached after approximately ten years of commissioned service and is an indication that the officer intends to stay in the Navy.

That is not to say that promotion to O4 is the only important accomplishment for naval officers in this study, rather it is simply the highest career milestone observed in this data set and it will be the basis for comparison between nearly all other variable categories.

Table 1 shows frequencies and means for the variables used in the multivariate models.



**Table 1.--** Frequencies and Means of Modeled Variables:

Variable	Frequency (number of sample)	Means
WHITE	6,431	0.9137
NONWHT	607	0.0862
MARRIEDL	3,197	0.4542
MARRIEDH	2,935	0.4170
PRENL2YR	1,054	0.1498
VLOWGPA	23	0.0033
LOWGPA	575	0.0817
FAIRGPA	2,285	0.3247
GOODGPA	2,930	0.4163
HIGHGPA	925	0.1314
VHIGHGPA	300	0.0426
ENGMAJOR	1,701	0.2417
BUSMAJOR	1,216	0.1728
HUMMAJOR	821	0.1167
SOCMAJOR	1,356	0.1927
SCIMAJOR	1,079	0.1533
MATMAJOR	664	0.0943
USNA	1,867	0.2652
ROTC_HI	1,220	0.1733
ROTC_LO	745	0.1059
OCS_HI	1,187	0.1687
OCS_LO	1,721	0.2445
NESEP	246	0.0350
CGEXP	5,373	0.7634
YR2SWOQL	2,115	0.3005
TOPFIT12	3,645	0.5179
TOPFIT3	3,031	0.4307
LCSTAY	3,742	0.5317
PROMO4	2,889	0.4105

Frequencies and means based on 7038 observations - except PROMO4 and MARRIEDH based on 3742 observations, MAJOR based on 6837, and SOURCE based on 6986.

## **E. METHODOLOGY**

Methodologies used in this thesis include cross-tab frequency tables and multivariate binary LOGIT models. LOGIT models can be used to calculate the effect of each independent variable on the probability of the outcome. These marginal effects represent the difference in probability of the outcome occurring when a base case variable changes by one count.

Estimation results of several promotion models will be compared to separate the direct effects of demographics and early Navy career experiences from the indirect effects of these factors. As models increase in complexity, the marginal effect of a given variable may either decrease or remain unchanged. A decrease in the marginal effect as variables are added indicates that there is a relationship between the added variable and affected variable. For example, if, in a promotion model, the marginal effect for NONWHT decreases (moves closer to zero) when commissioning source variables are added, one can conclude that there is a relationship between not only commissioning source and promotion, but between commissioning source and NONWHT as well. Therefore, the indirect effect of commissioning source on NONWHT may help explain some of the effect of minority status on promotion.

The choice of modeling technique was due in part to the construction of the data set. Cross-tab frequency tables are developed and used for preliminary analysis. Cross-tabs provide information in both absolute and relative terms, and help formulate the questions which more sophisticated modeling techniques will attempt to answer.

The use of dichotomous dependent variables encourages the use of non-linear estimation techniques such as binary LOGIT or binary PROBIT. These methods provide maximum likelihood estimates (MLE) of the probability of an event occurring. The choice between LOGIT and PROBIT modeling is academic since the two are, for the most part, indistinguishable near the mean value of each variable. This study utilizes LOGIT modeling:

$$L_i = \ln(P_i / 1-P_i)$$

where  $L_i$  is the LOGIT of the  $i^{\text{th}}$  variable, and  $P_i = E(Y = 1 | X_i) = \beta_1 + \beta_2 X_i + \dots + \beta_n X_i$ , and is the probability associated with the  $i^{\text{th}}$  variable.



## IV. ANALYSIS

This thesis seeks to answer the following four questions:

- (1) What factors influence junior surface naval officer performance measures?
- (2) What factors influence junior naval officer retention?
- (3) What factors influence junior surface naval officer promotion to Lieutenant Commander?
- (4) What is the differential effect of minority status on junior surface naval officer performance, retention, and promotion to Lieutenant Commander?

Six models are developed to address these questions. These six models are considered the "primary" models and follow, as much as possible, the same chronological order that has been used to this point. Some overlapping occurs since many of the same variables are used in multiple models. In addition to the six primary models, several promotion models are specified to isolate characteristics which affect minority status coefficients. These "secondary" models are discussed in this chapter and are provided in appendix C.<sup>3</sup>

Model One estimates the effect of selected variables with respect to their influence on receiving top fitness report scores (TOPFIT12) during the grades of O1 (ENS) and O2 (LTJG). Model Two explores the relationships between many of the same

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<sup>3</sup> Primary models are shown in appendix B, and variable descriptions are given in Chapter II and Appendix A.

variables and Surface Warfare Officer Qualification (YR2SWOQL). Model Three examines factors affecting CRUDES assignment (CGEXP). Model Four is very similar to Model One and estimates the influence of several characteristics on receiving top fitness report scores as an O3 (LT). And finally, Models Five and Six examine the issues of retention to the O4 (LCDR) board (LCSTAY) and promotion to O4 (PROMO4), respectively.

#### **A. PERFORMANCE**

To address the first issue of what factors influence junior surface naval officer performance measures, four models will be discussed. These models measure the influence of several junior officer post-commissioning factors on such dependent variables as fitness report scores, warfare qualification results, and ship assignment.

##### **1. Performance (TOPFIT12) Model**

The first model examines the factors which influence the dependent variable TOPFIT12. Recall from Chapter II that TOPFIT12 refers to the frequency by which an individual received superior fitness report scores as an O1 (ENS) and O2 (LTjg). That is, TOPFIT12=1 if an individual is recommended for accelerated promotion (RAP) at least 75 percent of the time on Ensign and Lieutenant junior grade FITREP's. TOPFIT12=0 if an individual receives fewer than 75 percent RAP'ed FITREPS during these grades.

Table 2 displays selected results of the TOPFIT12 LOGIT model. This model explains the influence of selected variables on being RAP'd at least 75 percent of the time during grades O1 (ENS) and O2 (LTjg).

**Table 2.--TOPFIT12 LOGIT Performance Model:**

<b>VARIABLE NAME</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD ERROR</b>	<b>CHI-SQUARE</b>	<b>MARGINAL EFFECT</b>
<b>NONWHT</b>	-0.4118***	0.0967	18.1353	-0.1025
<b>AGEO1</b>	-0.0431***	0.0153	7.9123	-0.0107
<b>HIGHGPA</b>	0.2001**	0.0834	5.7539	0.0494
<b>BUSMAJOR</b>	0.2295***	0.0847	7.3426	0.0570
<b>OCS_LO</b>	-0.2095**	0.0902	5.3911	-0.0523
<b>NESEP</b>	0.6866***	0.1770	15.0484	0.1593
<b>CGEXP</b>	0.1319**	0.0627	4.4203	0.0329
<b>YR2SWOQL</b>	1.4494***	0.0612	560.3961	0.3352

<p>n=7038 TOPFIT12=1 (3645) TOPFIT12=0 (3393) Concordant = 73.4%      Discordant = 26.3%      Tied = 0.3% -2 Log likelihood = 8475.7</p>
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Note: Table shows only significant variables. See Appendix B for full model description.  
Level of significance: \*\*\*=99 percent, \*\*=95 percent, \*=90 percent.

Table 2 shows that minority officers are 10 percent less likely to be RAP'ed on at least 75 percent of their O1/O2 FITREP's, even after controlling for pre-commissioning education and early Navy career experiences. This estimate is found to be significant at the 99 percent level. Having a high GPA and being a business major increases one's chances of meeting TOPFIT12 criteria by about 5 percent over having a good GPA and being an engineering major. But, with the exception of HIGHGPA and BUSMAJOR, undergraduate education has little to do with junior surface officer performance,

suggesting that surface officers start out on an even playing field and are evaluated on post-commissioning performance and not pre-commissioning factors. The most influential factor in the TOPFIT12 model is timely SWO qualification. Junior officers who qualify within two years of commissioning are 33 percent more likely to receive at least 75 percent RAP'ed fitness reports, as Ensigns and Lieutenant junior grades, than those who fail to meet this qualification milestone. Having CRUDES experience increases the probability of being RAP'd by 3 percent points.

## **2. SWO Qualification (YR2SWOQL) Model**

SWO qualification appears to have a very large impact on junior naval officer performance measures. Model Two, YR2SWOQL, examines which demographic characteristics and early naval experiences may contribute to the timely attainment of this qualification.



**Table 3.-- LOGIT Model Explaining SWO Qualification Within Two Years:**

<b>VARIABLE NAME</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD ERROR</b>	<b>CHI-SQUARE</b>	<b>MARGINAL EFFECT</b>
<b>NONWHT</b>	-0.4959***	0.1049	22.3647	-0.0931
<b>BUSMAJOR</b>	0.5724***	0.0845	45.9312	0.1170
<b>HUMMAJOR</b>	0.3254***	0.1041	9.7792	0.0272
<b>SOCMAJOR</b>	0.4437***	0.0826	28.8649	0.0883
<b>SCIMAJOR</b>	0.3417***	0.0889	14.7638	0.0665
<b>MATMAJOR</b>	0.3111***	0.1016	9.3847	0.0601
<b>ROTC_LO</b>	-0.2710***	0.0964	7.9116	-0.0587
<b>ROTC_HI</b>	-0.2803***	0.0825	11.5543	-0.0606
<b>OCS_LO</b>	-0.4142***	0.0914	20.5497	-0.0872
<b>OCS_HI</b>	-0.4544***	0.0930	23.8913	-0.0949
<b>PRENL2YR</b>	0.2668**	0.1077	6.1406	0.0571
<b>CGEXP</b>	0.6007***	0.0687	76.5202	0.1153

n=7038 YR2SWOQL=1 (2115) YR2SWOQL=0 (4923)  
 Concordant = 62.3%      Discordant = 37.1%      Tied = 0.6%  
 -2 Log likelihood = 8315.3

Note: Table shows only significant variables. See Appendix B for full model description.  
 Level of significance: \*\*\*=99 percent, \*\*=95 percent, \*=90 percent.

Table 3 shows that the probability that minority officers achieve SWO qualification within two years is 10 points lower than for whites. The fact that the model includes the full range of pre-commissioning and post-commissioning variables rules out the likelihood of direct effects from those factors. One possible answer to this disparity is

in the type of billets filled by minority officers as compared to those filled by non-minority officers.

As pointed out in Chapter II, prior studies have found that billet assignment may play a significant role in timely warfare qualification achievement (Bellamy 1991). The more demanding the billet, the less time an officer has to devote to the qualification effort. A shortcoming of this study is that it does not include variables for billet assignment. If the minority officers in this study are more likely to be assigned to more demanding billets, it is possible that the disparity in timely SWO qualification is due, at least in part, to the indirect effects of billet assignment.

This study finds that undergraduate degree type impacts timely SWO qualification. When compared to the reference degree type (engineering degree), every other type has a positive influence on qualification. In general, less technical degrees increase the probability of qualification compared to more technical degrees. Like the minority officer SWO qualification rate disparity, this too may be related to the indirect effects of billet assignment. Cross-tab analysis reveals that engineering majors are more likely than non-engineers to serve on CRUDES ships. It would seem intuitive, therefore, that if ship type matters, engineering majors would enjoy a higher qualification rate than non-engineering majors. But, if engineering majors are assigned to the more demanding engineering billets at a higher rate than non-engineering majors, the positive influence of CRUDES assignment may be out-weighed by the negative effect of the more demanding billet assignments, which reduce the time a junior officer has to devote to qualifying.

Commissioning source variables have the greatest impact of all variables in the SWO qualification model. With the exception of NESEP, which, though negative, proves to be insignificant, all commissioning sources studied have significant negative impacts on timely SWO qualification when compared to the reference variable USNA. This finding supports the Mehay and Bowman (1995) study which suggests that Naval Academy graduates may possess a greater stock of firm specific capital than their non-Academy peers, and that exposure to the rigors of Naval Academy life may better prepare a junior surface officer for early life in the Navy.

Another interesting finding is that GPA, arguably a measure of cognitive achievement, is not significant in SWO qualification models. It is apparent though, that GPA is positively related to CRUDES assignment, and since CRUDES assignment has such a large influence on timely SWO qualification, the indirect effect of GPA on SWO qualification is captured by the CRUDES variable. Further, the indirect effects of GPA and ship assignment may contribute to observed SWO qualification rate differences by minority status.

### **3. CRUDES Experience (CGEXP) Model**

As stated earlier, assignment to Frigates, Destroyers, or Cruisers is believed to have a positive effect on the professional qualification process for junior surface officers. And, as discussed above in Model 1 (TOPFIT12), timely warfare qualification has been shown to influence junior officer performance measures (FITREP's). Variables which prove to be significant in CRUDES experience models may have far reaching impacts as

CRUDES assignment seems to affect a variety of professional milestones for junior surface officers. Table 4 contains the results of a LOGIT estimation of CRUDES experience.

**Table 4.--LOGIT Model Describing CRUDES Experience (CGEXP):**

VARIABLE NAME	LOGIT COEFFICIENT	STANDARD ERROR	CHI-SQUARE	MARGINAL EFFECT
NONWHT	-0.3482***	0.0966	12.9786	-0.0659
AGEO1	-0.0336**	0.0160	4.4058	-0.0059
LOWGPA	-0.5804***	0.1036	31.3010	-0.1142
FAIRGPA	-0.1472**	0.0675	4.7553	-0.0260
HIGHGPA	0.2142**	0.0956	5.0223	0.0342
HUMMAJOR	-0.4837***	0.1045	21.4371	-0.0890
SOCMAJOR	-0.2148***	0.0896	5.7411	-0.0368
MATMAJOR	-0.2882***	0.1103	6.8231	-0.0504
ROTC_LO	-0.3317***	0.1078	9.4745	-0.0534
ROTC_HI	-0.4578***	0.0926	24.4141	-0.0764
OCS_LO	-0.5084***	0.0993	26.2095	-0.0861
OCS_HI	-0.4458***	0.1010	19.4843	-0.0742

n=7038 CGEXP=1 (5373) CGEXP=0 (1665) Concordant = 61.9%      Discordant = 37.4%      Tied = 0.7% -2 Log likelihood = 7457.1		
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Note: Table shows only significant variables. See Appendix B for full model description. Level of significance: \*\*\*=99 percent, \*\*=95 percent, \*=90 percent.

This model shows that assignment to CRUDES is related to the undergraduate education factors GPA and major. Although the two extreme GPA categories, very low and very high, are not significant, they do follow the trend that suggests higher GPA's increase the probability of CRUDES assignment. Their insignificance may be due to the small number of observations in those categories.

Degree type, on the other hand, has mixed effects on CRUDES assignment. While all degree types have negative coefficients, only humanities, social science, and math majors are significantly less likely to lead to CRUDES assignment when compared to engineering majors. The reasons for the degree-type effect on CRUDES assignment is not clear. But it may be that engineering graduates have more of a preference for these technologically complex ships than their non-engineering peers; or that in addition to GPA, degree type is used in the initial ship detailing process. Cross-tab models do little to help explain these effects and further study is required before valid conclusions can be made.

The commissioning source variables ROTC and OCS also have negative coefficients in CRUDES experience models, which suggests that: 1) the initial assignment detailing process may favor USNA graduates over other commissioning sources; or 2) USNA graduates out-perform ROTC and OCS graduates in the fleet and are therefore detailed to follow-on CRUDES ships at a greater rate than both ROTC and OCS graduates; or 3) a combination of the two. The next model to be discussed (TOPFIT3) strongly supports option 2, but it does not rule out the other options.

Self-selection may represent a significant contribution to CRUDES assignment. USNA graduates are afforded the unique opportunity to be involved in the initial assignment process (supporting suggestion (1) above). They are allowed to choose their initial ship assignment based on undergraduate GPA, while no other commissioning source provides this opportunity. And, since CRUDES is generally considered the most desirable ship type it is no surprise that USNA graduates enjoy a greater CRUDES experience rate than any other commissioning source.

#### **4. Performance (TOPFIT3) Model**

This model measures surface officer performance at the O3 level. The dependent variable, TOPFIT3 = 1 if officers are RAP'd on at least 75 percent of their O3 (LT) fitness reports. See Chapter III and Appendix A for detailed descriptions of variables.

**Table 5.— TOPFIT3 LOGIT Performance Model:**

<b>VARIABLE NAMES</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD ERROR</b>	<b>CHI-SQUARE</b>	<b>MARGINAL EFFECT</b>
<b>NONWHT</b>	-0.2454**	0.0989	6.1570	-0.0585
<b>VHIGHGPA</b>	0.3551***	0.1332	7.1028	0.0879
<b>BUSMAJOR</b>	0.2029**	0.0845	5.7712	0.0495
<b>ROTC_LO</b>	-0.3866***	0.0967	15.9825	-0.0949
<b>ROTC_HI</b>	-0.2503***	0.0822	9.2667	-0.0620
<b>OCS_LO</b>	-0.4624***	0.0914	25.6175	-0.1128
<b>OCS_HI</b>	-0.4238***	0.0923	21.1089	-0.1037
<b>CGEXP</b>	0.5391***	0.0654	67.9990	0.1268
<b>YR2SWOQL</b>	0.5544***	0.0595	86.9364	0.1360
<b>TOPFIT12</b>	1.0514***	0.0562	349.4348	0.2496

<p>n=7038 TOPFIT3=1 (3031) TOPFIT3=0 (4007) Concordant = 73.7%      Discordant = 26.0%      Tied = 0.2% -2 Log likelihood = 8365.8</p>
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Note: Table shows only significant variables. See Appendix B for full model description.  
Level of significance: \*\*\*=99 percent, \*\*=95 percent, \*=90 percent.

Table 5 displays the results of a LOGIT model which estimates the influence of selected variables on being RAP'd at least 75 percent of the time during the grade of O3/LT. Not surprisingly, the TOPFIT3 performance model shares some commonalities with the TOPFIT12 performance model. To start with, minority status remains negative

and significant. However, the marginal effect of minority status is halved from -10.25 percent in the TOPFIT12 model to -5.85 percent in the TOPFIT3 model.

Continuing to compare the two performance models, higher GPA categories prove to be positive and significant predictors of top fitness report scores. Business majors still have the upper hand on all other degree types, and CRUDES experience and timely SWO qualification remain significant and positive. The negative effect of OCS\_LO in the early performance model is joined by OCS\_HI and the two ROTC variables while NESEP, which is positive and significant in earlier models, drops out of favor in the later performance model, becoming negative and insignificant.

Not surprisingly, the variable TOPFIT12 is positive and significant in TOPFIT3 model. It makes sense that outstanding performance as Ensigns and Lieutenant junior grades does not end with promotion to Lieutenant. Identification of superior talent at the O1/O2 level is the best predictor of superior O3 performance. Meeting the requirements of TOPFIT12 increases the probability of meeting the TOPFIT3 requirements by 25 percent. Not to mention, many of the TOPFIT12 individuals may have been evaluated by the same Commanding Officer at the TOPFIT3 level.

Estimating the TOPFIT3 model without the TOPFIT12 variable changes the NONWHT coefficient from -0.2454 to -0.3212, and the level of significance increases from 95 percent to 99 percent; marginal effects change from 5.9 percent, to 7.6 percent. The large increase in the SWO qualification effect (YR2SWOQL) is due to the interaction between SWO qualification and early performance measures (TOPFIT12) in



the earlier model. Table 6 shows results of the TOPFIT3 LOGIT Performance Model without the TOPFIT12 variable.

**Table 6.-- TOPFIT3 LOGIT Performance Model Without TOPFIT12 Variable:**

<b>VARIABLE NAMES</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD ERROR</b>	<b>CHI-SQUARE</b>	<b>MARGINAL EFFECT</b>
NONWHT	-0.3212***	0.0916	11.1662	-0.0763
AGE01	-0.0277*	0.0151	3.3695	-0.0067
HIGHGPA	0.1610**	0.0807	3.9817	0.0396
VHIGHGPA	0.3831***	0.1292	8.7896	0.0951
BUSMAJOR	0.2411***	0.0822	8.6051	0.0590
ROTC_LO	-0.3911***	0.0944	17.1522	-0.0962
ROTC_HI	-0.2442***	0.0801	9.2911	-0.0606
OCS_LO	-0.4813***	0.0888	29.3906	-0.1175
OCS_HI	-0.4255***	0.0895	22.6097	-0.1044
CGEXP	0.5419***	0.0637	72.3512	0.1281
YR2SWOQL	0.8527***	0.0562	230.2653	0.2090

<p>n=7038 TOPFIT3=1 (3031) TOPFIT3=0 (4007)</p> <p>Concordant = 69.9%      Discordant = 29.7%      Tied = 0.3%</p> <p>-2 Log likelihood = 8722.2</p>
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Note: Table shows only significant variables. See Appendix B for full model description.  
Level of significance: \*\*\*=99 percent, \*\*=95 percent, \*=90 percent.

An increase in the NONWHT marginal effect suggests that some of the effect of minority status on TOPFIT3 is due to the relationship between NONWHT and TOPFIT12. Recall from the TOPFIT12 model that the NONWHT variable has a coefficient of -0.4118 and is significant at the 99 percent level. That is to say, observed performance at the O3 (LT) level is correlated with early performance and can help explain some of the disparity in minority/non-minority performance measure differences throughout a junior surface officer's career. These observed performance differences may be related to ship assignment and SWO qualification results. They may also be a function of pre-commissioning factors like GPA and undergraduate major, which as models show, have indirect effects that influence future performance and opportunities.

#### **5. Retention (LCSTAY) Model**

Retention to the Lieutenant Commander promotion board is a significant accomplishment which occurs, for most individuals, at the point of ten years of commissioned service. Exceptions to the ten year rule-of-thumb are generally associated with prior enlisted service or promotion rate variances as a result of promotion board end-strength goals for a given year.

The retention model uses the dichotomous dependent variable LCSTAY to separate those who stay to the O4 promotion board screening from those who don't stay to that point. LCSTAY=1 if the individual stays and LCSTAY=0 if the individual does not stay. As pointed out in previous chapters, staying to the Lieutenant Commander promotion board is a strong predictor of career intentions. The retention model is the last

of the primary models developed in this thesis which uses the full 7038 observations in the data set. The remaining primary model, PROMO4, which estimates the influence of several variables on promotion board outcomes, uses a subset of the data since to be promoted one must first satisfy the LCSTAY=1 criteria.

The retention model holds the distinction of having the greatest number of significant variables of all the models developed for this study: 15 of the 23 evaluated variables are significant at the 99 percent level, and OCS\_LO is significant at the 95 percent level. The retention model is also the first model in which neither the minority nor the age variable have negative marginal effect coefficients.

**Table 7.-- LOGIT Retention (LCSTAY) Model:**

<b>VARIABLE NAME</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD ERROR</b>	<b>CHI-SQUARE</b>	<b>MARGINAL EFFECT</b>
NONWHT	0.3705***	0.1017	13.2800	0.0889
AGEO1	0.0645***	0.0167	15.0033	0.0159
LOWGPA	0.3521***	0.1078	10.6616	0.0852
FAIRGPA	0.2192***	0.0651	11.3296	0.0537
VHIGHGPA	-0.3980***	0.1437	7.3941	-0.0992
BUSMAJOR	-0.2965***	0.0891	11.0644	-0.0738
HUMMAJOR	-0.1906*	0.1050	3.2961	-0.0464
SCIMAJOR	0.1652*	0.0906	3.3249	0.0402
MATMAJOR	0.3503***	0.1072	10.6770	0.0837
ROTC_LO	0.3406***	0.0992	11.7993	0.0809
OCS_LO	-0.2073**	0.0950	4.7573	-0.0514
OCS_HI	-0.3560***	0.0961	13.7275	-0.0886
NESEP	1.1068***	0.2493	19.7109	0.2309
PRENL2YR	0.6604***	0.1152	32.8375	0.1551
CGEXP	1.2393***	0.0690	322.7911	0.2998
YR2SWOQL	0.3159***	0.0648	23.8065	0.0771
TOPFIT12	0.5257***	0.0622	71.5093	0.1290
TOPFIT3	1.1277***	0.0622	328.9081	0.2684

n=7038 LCSTAY=1 (3742) LCSTAY=0 (3296)  
 Concordant = 78.5%      Discordant = 21.3%      Tied = 0.2%  
 -2 Log likelihood = 7758.2

Note: Table shows only significant variables. See Appendix B for full model description.  
 Level of significance: \*\*\*=99 percent, \*\*=95 percent, \*=90 percent.

That so many variables are significant in the retention model makes it difficult to isolate trends that may help explain retention decisions. The fact that most of these variables have positive coefficients means that individuals who choose to stay in the Navy up to the Lieutenant Commander promotion board are quite unlike the reference individual used in the model. Noteworthy exceptions are OCS graduates, business majors, and individuals with very high GPA's, all of which possess a greater probability to leave the Navy than the reference individual. Recall that the reference individual is a hypothetical person possessing the characteristics of the omitted group of variables in the LOGIT model. The reference individual for the retention model possesses the following characteristics: white; good GPA (2.60 - 3.19); engineering major; USNA graduate; no CRUDES or prior enlisted experience; not SWO qualified within two years; and, did not receive at least 75 percent RAP'd FITREP's.

The most interesting finding in this regression is that the minority variable (NONWHT) is positive and significant, which, of course, means that minority junior surface naval officers are more likely to stay in the Navy than their non-minority peers. This is especially interesting in light of previous findings that suggest minority junior surface officers experience more difficulty meeting career milestones than non-minority officers, which intuitively would suggest that minority officers have a lower propensity for Navy life and a higher probability for attrition, on average.<sup>4</sup>

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<sup>4</sup> The ACOL model described in Chapter II may help explain the reasons for higher retention rates of minority junior surface naval officers.

The high retention rates of NESEP graduates and prior-enlisted officers, in general, is expected for two reasons. First, they already have a greater investment in their careers than individuals who enter the Navy with no previous experience. Second, the advantage of the realistic job preview discussed previously is expected to help prepare them for Navy life.

#### **6. Promotion (PROMO4) Model**

Promotion to Lieutenant Commander is the final milestone which this thesis considers. Lieutenant Commanders enjoy the distinction of having proven themselves as highly competent and successful naval officers. Attainment of this rank is a very significant accomplishment and worthy of accolade. The fact that it comes at the mid-point in many careers makes it a natural point of study in military manpower research. The retention of surface officers through this point is a key indicator of career intention since the Navy's up-or-out promotion structure prevents officers from staying if they fail to promote at a minimum rate. While officers not meeting the requirements for promotion to O4 (LCDR) generally leave the Navy shortly after promotion board results are known, officers who are promoted are likely to continue their Navy careers to at least the 20 year minimum retirement gate.

The promotion model is conditional on an individual staying up to the O4 board (i.e., 10 years of commissioned service). In other words, an officer must first have satisfied the condition that LCSTAY=1 to be included in the sample. Sample size for this model is 3742 observations, representing 53 percent of the original sample of 7038;

meaning that just over half of those officers who were observed at the O3 (LT) promotion screening board stay to the O4 (LCDR) promotion screening board. By far the most influential factors affecting promotion probability are the TOPFIT12 and TOPFIT3 variables, with marginal effects of 26 percent and 37 percent, respectively. Significant variables in the promotion model are displayed in the table below.

**Table 8.-- LOGIT Model Explaining Promotion to O4 (PROMO4):**

<b>VARIABLE NAME</b>	<b>LOGIT COEFFICIENT</b>	<b>STANDARD ERROR</b>	<b>CHI-SQUARE</b>	<b>MARGINAL EFFECT</b>
AGEO1	-0.1233***	0.0248	24.7805	-0.0282
VLOWGPA	-1.2194*	0.6749	3.2646	-0.2956
LOWGPA	-0.5480***	0.1617	11.4869	-0.1315
VHIGHGPA	0.4676*	0.2841	2.7087	0.0964
BUSMAJOR	-0.3921***	0.1495	6.8782	-0.0873
HUMMAJOR	-0.5094***	0.1700	8.9786	-0.1153
SOCMAJOR	-0.4181***	0.1422	8.6404	-0.0934
MATMAJOR	-0.3815**	0.1606	5.6463	-0.0848
ROTC_LO	-0.3870**	0.1554	6.2052	-0.0922
CGEXP	0.5932***	0.1230	23.2730	0.1404
YR2SWOQL	0.3893***	0.1060	13.4819	0.0868
MARRIEDH	0.2774***	0.1082	6.5734	0.0630
TOPFIT12	1.1477***	0.1018	127.1285	0.2587
TOPFIT3	1.7348***	0.1036	280.4410	0.3670

n=3742    PROMO4=1 (2889)    PROMO4=0 (853)		
Concordant = 81.6%	Discordant = 18.2%	Tied = 0.2%
-2 Log likelihood = 3110.4		

Note: Table shows only significant variables. See Appendix B for full model description.  
Level of significance: \*\*\*=99 percent, \*\*=95 percent, \*=90 percent.



Notice from Table 8 that, compared to the reference individual, all significant pre-commission variables have negative coefficients, while all significant post-commission variables have positive coefficients. The magnitude of most post-commission marginal effects supports the earlier assertion that good on-the-job performance is the best method to ensure a successful Navy career. But, completing an engineering degree at the Naval Academy, with a high GPA certainly adds to promotion prospects.

This is the only model in this study in which the NONWHT marginal effect is not significant (recall that the retention model is the only model in which the minority variable is positive and significant). The insignificance of the minority variable in the promotion model is arguably the most significant finding in this research. The fact that the NONWHT variable has a negative coefficient in all performance models, and that performance has the greatest marginal effect in promotion models, would lead one to expect NONWHT to be both negative and significant in this model. Performance (TOPFIT), experience (CGEXP), and qualification (YR2SWOQL) models all show NONWHT to have negative marginal effects. Yet, even when used as independent variables in the promotion model they appear to be over-shadowed by an unexplained influence which diminished the effect of NONWHT to the point of insignificance.

This raises the question "what conditions, or characteristics, within the promotion model determine the significance of the NONWHT variable?" To answer this question, secondary LOGIT models are estimated. By adding and dropping independent variables and groups of variables in the promotion (PROMO4) model, we attempt to isolate the

influence of each, noting when NONWHT goes from significant to insignificant.

Selected results of these models are explained below and full results are provided in Appendix D.

## **7. Minority Effect on Promotion**

In a basic promotion model that includes only pre-commissioning variables such as demographics (minority status, age at commissioning, prior enlisted service, and marital status at O4 promotion board), education (GPA, major and commissioning source), and time variables as regressors, the NONWHT variable has a coefficient of -0.4681 and is significant at the 99 percent level of significance. The computed marginal effect for NONWHT in this model is -0.9908, which indicates that minority junior surface naval officers lag non-minority officers in promotion probability by 9.91 percentage points.

Post-commissioning experience and performance are important inputs to promotion decisions and should be considered when evaluating promotion models. Adding the post-commission experience variables for SWO qualification (YR2SWOQL) and CRUDES experience (CGEXP) causes the absolute value of the marginal effect of minority status to decrease both in magnitude and in significance. The NONWHT marginal effect for this model is -6.81 points (-0.0681) and is significant at the 95 percent level of significance. As the model continues to expand it captures an increasing number of relevant characteristics that influence the promotion probability. The addition of performance factors (TOPFIT12 and TOPFIT3) completes the model and reduces the

marginal effect of minority status to -2.57 point (-0.0257) and causes the NONWHT variable coefficient to become insignificant.<sup>5</sup> Full model specifications are given in Appendix C.

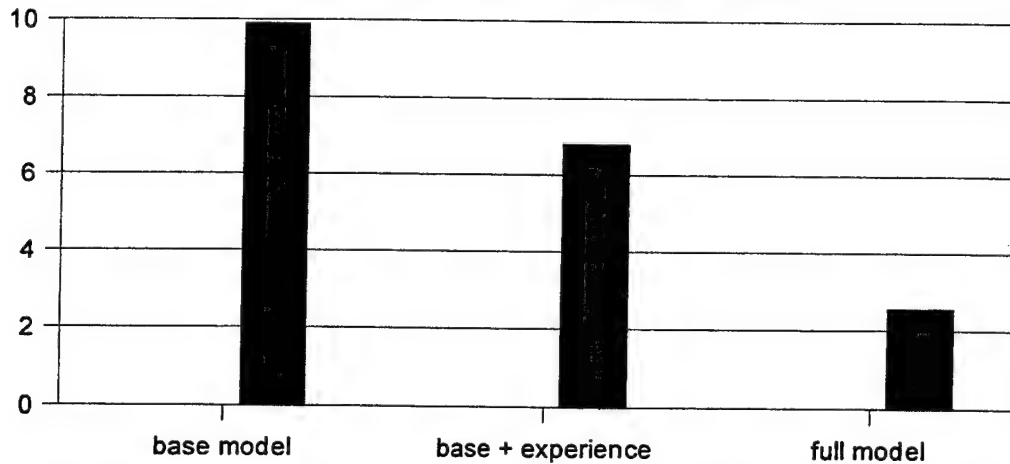
Though the minority effect does not disappear completely, even in the most comprehensive promotion models described in this study, the remaining promotion rate disparity may be due to unknown or un-observable factors which the model fails to identify. Additionally, that minority status becomes insignificant after the final variable group is included means that the NONWHT variable does not exert a strong enough influence in the promotion model to support a convincing argument that promotion to O4 (LCDR) is influenced by ethnicity. So, the question remains, how is it that the effect of minority status is insignificant in promotion models when it is so important in the performance models (TOPFIT12/3)? Perhaps there is some other unobserved force at work which serves to modify the influence of these seemingly crucial variables. A more complete study of the effects of ship type and billet assignment would add important information on this issue.

The chart below shows the effects, just discussed, of adding relevant characteristics to the promotion models. Appendix C gives full model results for all the secondary promotion models.

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<sup>5</sup> The level of significance for NONWHT in the full model is 0.5493. Generally, a level of significance of at least 0.90 is necessary for a variable to be considered statistically significant.

### Percentage Point Difference in Promotion Probability Between Whites and Non-Whites



\* Y axis represents percentage point difference in promotion probability between white and non-white junior surface officers.  
\* X axis represents model type as the number of explanatory variables are increased.

To summarize, the degree to which demographics and early Navy career experiences affect junior surface officer performance and promotion potential is an important issue, both for policy makers and for the officers themselves. The equitability of career opportunities is crucial if the Navy is to attract and retain quality individuals. The Navy's Surface Warfare Officer community has a reputation of being challenging and demanding, and real, or perceived, opportunity differences may influence an individual's decision to stay in the Navy or leave for a more attractive employment option.

Demographics, education, ship assignment, and performance are all significant predictors in the performance models. This thesis studies the effects of several significant variables and offers possible explanations for their influence. The use of binary LOGIT modeling techniques allow interaction between variables, which serves to help isolate the direct effect a given variable has on the modeled outcome. Table 9, below, summarizes the more significant findings in tabular form. The displayed values represent the impact each variable has in the associated models.

**Table 9-- Effect of Selected Variables by Model Type:**

	<b>SWO Qual</b>	<b>CRUDES EXP.</b>	<b>TOPFIT 01/02</b>	<b>TOPFIT 03</b>	<b>RETEN- TION</b>	<b>PROMO- TION</b>
<b>NONWHT</b>	-0.0931 ***	-0.0659 ***	-0.1025 ***	-0.058 **	0.0889 **	-0.025
<b>YR2SWOQL</b>	N/A	N/A	0.3352 ***	0.1360 ***	0.0771 ***	0.0868 ***
<b>CGEXP</b>	0.1153 ***	N/A	0.029 **	0.1268 ***	0.2998 ***	0.1404 ***
<b>TOPFIT12</b>	N/A	N/A	N/A	0.2496 ***	0.1290 ***	0.2587 ***
<b>TOPFIT3</b>	N/A	N/A	N/A	N/A	0.2684 ***	0.3670 ***

Level of significance as follows: \*\*\* = 99%, \*\* = 95%, \* = 90%, NS = not significant.

Table 9 shows marginal effects of selected variables in six primary models. Model names are along the top; variable names are down the left side. N/A means variable is not used in model.

Many times the reasons for a variable's impact in a particular model is not obvious, or it is related indirectly through its effect on other factors. LOGIT modeling does not identify indirect effects and assumptions must be made to explain the interaction. Unfortunately, it is often these unseen relationships which may contribute to biases in treatment of individuals or groups. As pointed out in Chapter I, the solutions to complex problems are never simple, and identification of indirect effects is a crucial first step in addressing questions related to equity.

## **VI. CONCLUSIONS**

### **A. SUMMARY**

Historically, our military has led the way in setting policy and implementing procedure designed to improve the quality of life for all its members. From controlling substance abuse to promoting equal rights and gender equality, our nation's military has often taken the lead in social research and development aimed at the reduction and eventual elimination of these and other intolerable social problems. In fact, the observed positive delta in minority junior officer retention rate found in this study may provide the foundation for a convincing argument in support of the Navy's success in promoting equal rights and opportunity, as compared to the private sector. That is to say, minority officers may choose to stay in the Surface Navy at a higher rate than non-minority officers because of the increased opportunities Navy life provides.

Though the models in this study do a very good job of explaining the direct influence of a number of variables on promotion, they cannot necessarily explain the indirect effects of important career enhancing opportunities. Assignment to CRUDES seems to be the first step toward a successful Surface Navy career, and individuals unfortunate enough to miss this opportunity may be faced with an up-hill battle to meet professional requirements and remain competitive for promotion. That is not to say, however, that the only way to succeed as a junior surface officer is to serve in CRUDES, and the reader should not lose hope because of it. It simply means that the Navy needs to

be aware of the importance of ship assignment and continue to offer a variety of ship types to junior officers so that they may be exposed to the opportunities that will help develop their naval careers.

Ship assignment is not the only pre-commission characteristic which affects the mix of the Surface Navy. Commissioning source plays a significant role in retention models as well. Different commissioning source programs carry with them varying requirements for obligated service, and additional requirements may be imposed for graduates pursuing designators with high training costs and long training pipelines such as aviation and nuclear power programs. But, in general, junior officers pursuing surface warfare assignment have a four or five year obligation upon graduation. Intuitively, one would think that graduates of fully funded education programs would have a greater propensity to leave the Navy when their obligation is served. But just the opposite is true for the individuals in this study. OCS graduates, most of whom fund their own education, are much more likely to attrite than any other commissioning source graduates. This would suggest that OCS graduates may enter the Navy without a good understanding of what to expect and then become dissatisfied at a higher rate than others who may have different expectations. Providing an opportunity for a realistic job preview might help curb the high attrition rate in this important commissioning program.

By now, the reader should be aware that what sometimes appears to be unfair advantage can be explained, at least partially, by exploring the interaction of background characteristics with observed outcomes. For example, the apparent disparity in surface



officer promotion rates between minorities and whites is nearly eliminated with the inclusion of performance and experience variables, which themselves can be traced to pre-commissioning experiences and choices. It is the indirect effect of these which sets the tone for performance and experience opportunities after commissioning, and the prospective surface naval officer would be well advised to consider such things as GPA and undergraduate major at the earliest possible opportunity, as they tend to shape the future.

There is arguably no more demanding yet rewarding job than that of a surface naval officer, and the key to a successful career is hard work and strong character. The Surface Navy life is hard, but together with the long hours and often miserable working conditions come the rewards associated with leadership and national service. The career-minded junior officer has only to do his or her best, and maintain a positive attitude and success will follow.

## **B. RECOMMENDATIONS**

The current practice of split JO tours, and assignment to ships with distinctively different operational missions, is an excellent way to even the playing field for all junior surface officers while simultaneously creating a diverse combat force. Serving half of one's Division Officer tour on a particular platform type and then the second half on a very different platform type is arguably a good practice to help develop junior officers. Understandably, this routine comes at no small cost, and that the Navy is willing to invest a significant portion of its budget in human capital, by providing these career enhancing

reassignments to junior officers, says a lot about the Navy's interest in the development of professional, career-minded officers. However, the first tour assignment process, which is linked to undergraduate GPA, may need to be reviewed.

While it is true that superior performance in college should be rewarded, the effect of ship assignment preference due to GPA may be counter productive in the development of career naval officers. Retention models in this study show that surface naval officers with the highest GPA's (3.60 - 4.00) are 10 percent less likely to stay in the Navy to the O4 (LCDR) promotion board than those with good GPA's (2.60 - 3.19). Also, though the upper GPA categories are correlated with performance, in general, GPA does not prove to be an overwhelmingly important factor in predicting fitness report scores or SWO qualification. This may mean that pre-commission background is not always an indication of post-commission performance, and that affording those with the highest probabilities of retention the best opportunities may pay the greatest dividends in the long run.

As initial ship assignments are made, consideration for an equitable distribution by ship type across commissioning sources and minority status is important to ensure equal career opportunity. It is difficult to say whether assignment to CRUDES increases an officer's probability for success or if the practice of assigning ship type by college performance results in the brighter and more highly motivated JO's receiving CRUDES assignment. But, results of this study show that white officers are assigned CRUDES platforms at a higher rate than non-white officers (61.6 percent and 50.3 percent,

respectively), and that the Naval Academy leads all commissioning source initial CRUDES assignment. See Table 10 below.

**Table 10-- Initial CRUDES Assignment by Commissioning Source and Ethnicity:**

	USNA	NROTC_S	NROTC_C	OCS	NESEP
WHITE	68.28	62.12	53.96	58.10	60.70
NON-WHITE	59.43	60.00	31.43	41.53	47.06

Percentages are based on CRUDES 'initial assignment' sample of 3962 White and 305 Non-White Surface Officers.

Table 10 shows percentages, by commissioning source and ethnicity, of CRUDES assignment. For example: of 3962 White Surface Officers graduating from the Naval Academy, 68.28 percent were assigned to CRUDES ships as their initial ship type.

\* model is restricted to those assigned CRUDES as initial assignment

#### **Specific recommendations:**

1. Review current practice of ship assignment based on GPA.
2. Continue practice of split JO tours to different ship types.
3. Provide realistic job previews to all officer accessions before making large financial investments in them.
4. Study the effects of ship and billet assignment both separately and as interactive variables.
5. Expand accession opportunities for prior enlisted personnel.
6. Consider SWO career incentive pay which targets the O3 (LT) to O4 (LCDR) retention problem.



## APPENDIX A

<u>Variables</u>	<u>Description</u>
WHITE	Caucasian officers
NONWHT	Officers other than White officers
AGE01	Age at time of commissioning
VLOWGPA	GPA range of 0-1.89
LOWGPA	GPA range of 1.90-2.19
FAIRGPA	GPA range of 2.20-2.59
GOODGPA	GPA range of 2.60-3.19
HIGHGPA	GPA range of 3.20-3.59
VHIGHGPA	GPA range of 3.60-4.00
SCIMAJOR	Undergraduate Biology/Physical Sciences degree
MATMAJOR	Undergraduate Math/Computer Science/Operational Analysis degree
ENGMAJOR	Undergraduate Engineering degree
SOCMAJOR	Undergraduate Social Sciences degree
BUSMAJOR	Undergraduate Business/Economics degree
HUMMAJOR	Undergraduate Humanities/NEC degree
USNA	Accession source via United States Naval Academy
ROTC_HI	Accession source via Naval Reserve Officers Training Corps combined with a <u>Barron's Profile of American Colleges</u> index of 1-3

**APPENDIX A**  
**(cont.)**

ROTC_LO	Accession source via Naval Reserve Officers Training Corps combined with a <u>Barron's Profile of American Colleges</u> index of 4-6
OCS_HI	Accession source via Officer Candidate's School combined with a <u>Barron's Profile of American Colleges</u> index of 1-3
OCS_LO	Accession source via Officer Candidate's School combined with a <u>Barron's Profile of American Colleges</u> index of 4-6
NESEP	Accession source via Navy Education Selective Engineering Program
PRENL2YR	Prior Enlisted for 2+ Years before commissioning
CGEXP	CRUDES experience between commissioning and Lieutenant Commander Promotion Board
2YRSWOQL	Surface Warfare Officer Qualified within 2 years of reporting to first ship assignment
SINGLE	Never married, or Divorced at time of promotion board
MARRIEDL	Married, with or without children, at time of O3 Promotion Board
MARRIEDH	Married, with or without children, at time of O4 Promotion Board
TOPFIT12	Officer receives a RAP on 75 percent or more of valid FITREP's during grades O1/O2
TOPFIT3	Officer receives a RAP on 75 percent or more of valid FITREP's during grade O3

**APPENDIX A**  
**(cont.)**

LCSTAY	Continued through grade O4 promotion board
PROMO4	Promoted to Lieutenant Commander either early or in-zone
FYXX	Fiscal year control variable





## APPENDIX B

Note: Though not listed, all models in this appendix include fiscal year control variables.

TOPFIT12 - Performance Model Specification

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	1.4826	0.3487	18.0732	0.0001
NONWHT	-0.4118	0.0967	18.1353	0.0001
AGEO1	-0.0431	0.0153	7.9123	0.0045
PRENL2YR	0.0453	0.1068	0.1801	0.6713
VLOWGPA	-0.6584	0.4861	1.8351	0.1755
LOWGPA	0.0005	0.1022	0.0000	0.9963
FAIRGPA	-0.0987	0.0621	2.5210	0.1123
HIGHGPA	0.2001	0.0834	5.7539	0.0165
VHIGHGPA	0.2076	0.1333	2.4262	0.1193
BUSMAJOR	0.2295	0.0847	7.3426	0.0067
HUMMAJOR	0.1503	0.0995	2.2837	0.1307
SOCMAJOR	0.1160	0.0817	2.0152	0.1557
SCIMAJOR	0.0518	0.0867	0.3569	0.5502
MATMAJOR	-0.0361	0.1005	0.1287	0.7198
ROTC_LO	-0.0960	0.0963	0.9948	0.3186
ROTC_HI	-0.0243	0.0822	0.0872	0.7678
OCS_LO	-0.2095	0.0902	5.3911	0.0202
OCS_HI	-0.1354	0.0911	2.2096	0.1372
NESEP	0.6866	0.1770	15.0484	0.0001
CGEXP	0.1319	0.0627	4.4203	0.0355
YR2SWOQL	1.4494	0.0612	560.3961	0.0001
n=7038   -2 Log likelihood=8475.7   Concordant=73.4%   Discordant=26.3%   Tied=0.3%				

**APPENDIX B**  
**(cont.)**

YR2SWOQL - SWO Qualification Model Specification

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	-0.6494	0.3527	3.3419	0.0675
NONWHT	-0.4959	0.1049	22.3647	0.0001
AGE01	-0.0172	0.0156	1.2090	0.2715
VLOWGPA	-0.4518	0.5160	0.7669	0.3812
LOWGPA	-0.1502	0.1076	1.9507	0.1625
FAIRGPA	0.0715	0.0628	1.2977	0.2546
HIGHGPA	0.0015	0.0839	0.0003	0.9854
VHIGHGPA	0.1023	0.1327	0.5947	0.4406
BUSMAJOR	0.5724	0.0845	45.9312	0.0001
HUMMAJOR	0.3254	0.1041	9.7792	0.0018
SOCMAJOR	0.4437	0.0826	28.8649	0.0001
SCIMAJOR	0.3417	0.0889	14.7638	0.0001
MATMAJOR	-0.3111	0.1016	9.3847	0.0022
ROTC_LO	-0.2710	0.0964	7.9116	0.0049
ROTC_HI	-0.2803	0.0825	11.5543	0.0007
OCS_LO	-0.4142	0.0914	20.5497	0.0001
OCS_HI	-0.4544	0.0930	23.8913	0.0001
NESEP	-0.1163	0.1753	0.4400	0.5071
PRENL2YR	0.2668	0.1077	6.1406	0.0132
CGEXP	0.6007	0.0687	17.5202	0.0001
n=7038   -2 Log likelihood=8315.3   Concordant=62.3%   Discordant=37.1%   Tied=0.6%				

**APPENDIX B**  
**(cont.)**

**CGEXP -- CRUDES Experience Model Specification**

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	1.9675	0.3604	29.8009	0.0001
NONWHT	-0.3482	0.0966	12.9786	0.0003
AGEO1	-0.0336	0.0160	4.4058	0.0358
PRENL2YR	0.1736	0.1125	2.3811	0.1228
VLOWGPA	-0.1080	0.4815	0.0503	0.8226
LOWGPA	-0.5805	0.1036	31.4010	0.0001
FAIRGPA	-0.1472	0.0675	4.7553	0.0292
HIGHGPA	0.2142	0.0956	5.0223	0.0250
VHIGHGPA	0.1522	0.1556	0.9565	0.3281
BUSMAJOR	-0.0497	0.0941	0.2789	0.5974
HUMMAJOR	-0.4837	0.1045	21.4371	0.0001
SOCMAJOR	-0.2148	0.0896	5.7411	0.0166
SCIMAJOR	-0.1338	0.0967	1.9123	0.1667
MATMAJOR	-0.2882	0.1103	6.8231	0.0090
ROTC_LO	-0.3317	0.1078	9.4745	0.0021
ROTC_HI	-0.4578	0.0926	24.4141	0.0001
OCS_LO	-0.5084	0.0993	26.2095	0.0001
OCS_HI	-0.4458	0.1010	19.4843	0.0001
NESEP	-0.1924	0.2026	0.9020	0.3422
n=7038   -2 Log likelihood=7457.1   Concordant=61.9%   Discordant=37.4%   Tied=0.7%				

**APPENDIX B**  
**(cont.)**

**TOPFIT3 - Performance Model Specification**

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	-0.3653	0.3556	1.0556	0.3042
NONWHT	-0.2454	0.0989	6.1570	0.0131
AGEO1	-0.0185	0.0155	1.4113	0.2348
PRENL2YR	0.1108	0.1079	0.0551	0.3043
VLOWGPA	0.4581	0.4452	1.0586	0.3035
LOWGPA	-0.0342	0.1041	0.1077	0.7428
FAIRGPA	-0.0430	0.0630	0.4664	0.4947
HIGHGPA	0.1232	0.0829	2.2098	0.1371
VHIGHGPA	0.3551	0.1332	7.1028	0.0077
BUSMAJOR	0.2029	0.0845	5.7712	0.0163
HUMMAJOR	0.1326	0.1011	1.7215	0.1895
SOCMAJOR	0.1017	0.0821	1.5353	0.2153
SCIMAJOR	0.0082	0.0877	0.0088	0.9252
MATMAJOR	0.0561	0.1011	0.3079	0.5790
ROTC_LO	-0.3866	0.0967	15.9825	0.0001
ROTC_HI	-0.2503	0.0822	9.2667	0.0023
OCS_LO	-0.4624	0.0914	25.6175	0.0001
OCS_HI	-0.4238	0.0923	21.1089	0.0001
NESEP	-0.2138	0.1771	1.4576	0.2273
CGEXP	0.5391	0.0654	67.9990	0.0001
YR2SWOQL	0.5544	0.0595	86.9364	0.0001
TOPFIT12	1.0514	0.0562	349.4348	0.0001
n=7038   -2 Log likelihood=8365.8   Concordant=73.7%   Discordant=26.0%   Tied=0.2%				

**APPENDIX B**  
**(cont.)**

LCSTAY - Retention Model Specification

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	-4.5377	0.3894	135.7861	0.0001
NONWHT	0.3705	0.1017	13.2800	0.0003
AGEO1	0.0645	0.0167	15.0033	0.0001
MARRIEDL	0.0592	0.0575	1.0606	0.3031
VLOWGPA	0.4747	0.4920	0.9311	0.3346
LOWGPA	0.3521	0.1078	10.6616	0.0011
FAIRGPA	0.2192	0.0651	11.3296	0.0008
HIGHGPA	-0.1150	0.0886	1.6844	0.1943
VHIGHGPA	-0.3908	0.1437	7.3941	0.0065
BUSMAJOR	-0.2965	0.0891	11.0644	0.0009
HUMMAJOR	-0.1906	0.1050	3.2961	0.0694
SOCMAJOR	0.0625	0.0857	0.5325	0.4656
SCIMAJOR	0.1652	0.0906	3.3249	0.0682
MATMAJOR	0.3503	0.1072	10.6770	0.0011
ROTC_LO	0.3406	0.0992	11.7993	0.0006
ROTC_HI	-0.0022	0.0845	0.0007	0.9796
OCS_LO	-0.2073	0.0950	4.7573	0.0292
OCS_HI	-0.3560	0.0961	13.7275	0.0002
NESEP	1.1068	0.2493	19.7109	0.0001
PRENL2YR	0.6604	0.1152	32.8375	0.0001
CGEXP	1.2393	0.0690	322.7911	0.0001
YR2SWOQL				
TOPFIT12	0.5257	0.0622	71.5093	0.0001
TOPFIT3	1.4494	0.0612	560.3961	0.0001
n=7038   -2 Log likelihood=7758.2   Concordant=78.5%   Discordant=21.3%   Tied=0.2%				

**APPENDIX B**  
(cont.)

PROMO4 - Promotion Model Specification

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi Square
INTERCEPT	1.1332	0.5795	3.8234	0.0505
NONWHT	-0.1110	0.1472	0.5689	0.4507
AGE01	-0.1233	0.0248	24.7805	0.0001
MARRIEDH	0.2774	0.1082	6.5734	0.0104
VLOWGPA	-1.2194	0.6749	3.2646	0.0708
LOWGPA	-0.5480	0.1617	11.4869	0.0007
FAIRGPA	-0.1269	0.1052	1.4540	0.2279
HIGHGPA	0.1258	0.1526	0.6799	0.4096
VHIGHGPA	0.4676	0.2841	2.7087	0.0998
BUSMAJOR	-0.3921	0.1495	6.8782	0.0087
HUMMAJOR	-0.5094	0.1700	8.9786	0.0027
SOCMAJOR	-0.4181	0.1422	8.6404	0.0033
SCIMAJOR	-0.2293	0.1523	2.2675	0.1321
MATMAJOR	-0.3815	0.1606	5.6463	0.0175
ROTC_LO	-0.3870	0.1554	6.2052	0.0127
ROTC_HI	-0.1303	0.1484	0.7699	0.3802
OCS_LO	0.0866	0.1623	0.2844	0.5938
OCS_HI	0.1352	0.1718	0.6196	0.4312
NESEP	-0.0183	0.2507	0.0053	0.9418
PRENL2YR	-0.0537	0.1662	0.1045	0.7464
CGEXP	0.5932	0.1230	23.2730	0.0001
YR2SWOQL	0.3893	0.1060	13.4819	0.0002
TOPFIT12	1.1477	0.1018	127.1285	0.0001
TOPFIT3	1.7348	0.1036	280.4410	0.0001

n=3742   -2 Log likelihood=3110.4   Concordant=81.6%   Discordant=18.2%   Tied=0.2%

## APPENDIX C

Note: Though not listed, all models in this appendix include fiscal year control variables.

### Secondary (Promotion) LOGIT models

These models are developed to help explain the influence of relevant variable groups as models are increased in complexity, and to explore the underlying basis for observed minority promotion probability differences.

#### Number (1) Secondary Promotion Model Specification:

Base model: includes demographics and pre-commissioning experiences

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	3.8720	0.5022	59.4438	0.0001
NONWHT	-0.4681	0.1299	12.9857	0.0003
AGE01	-0.1274	0.0221	33.3246	0.0001
MARRIEDH	0.3829	0.0965	15.7561	0.0001
PRENL2YR	-0.0838	0.1482	0.3196	0.5718
VLOWGPA	-1.3430	0.5577	5.7984	0.0160
LOWGPA	-0.5723	0.1430	16.0200	0.0001
FAIRGPA	-0.1554	0.0949	2.6793	0.1017
HIGHGPA	0.2758	0.1390	3.9405	0.0471
VHIGHGPA	0.5807	0.2587	5.0368	0.0248
BUSMAJOR	-0.0484	0.1331	0.1321	0.7173
HUMMAJOR	-0.3080	0.1533	4.0354	0.0446
SOCMAJOR	-0.2530	0.1263	4.0129	0.0452
SCIMAJOR	-0.1532	0.1385	1.2246	0.2685
MATMAJOR	-0.3266	0.1455	5.0374	0.0248
ROTC_LO	-0.4836	0.1395	12.0076	0.0005
ROTC_HI	-0.1657	0.1333	1.5437	0.2141
OCS_LO	0.0389	0.1462	0.0706	0.7904
OCS_HI	0.2038	0.1562	1.7030	0.1919
NESEP	0.1679	0.2259	0.5526	0.4573
n=3742   -2 Log likelihood=3758.0   Concordant=67.0%   Discordant=32.5%   Tied=0.5%				

**APPENDIX C**  
**(cont.)**

Number (2) Secondary Promotion Model Specification

Base Model Plus SWO Qualification and CRUDES Variables

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	3.0158	0.5250	33.0017	0.0001
NONWHT	-0.3237	0.1332	5.9059	0.0151
AGE01	-0.1237	0.0226	29.9591	0.0001
MARRIEDH	0.3282	0.0984	11.1156	0.0009
PRENL2YR	-0.1225	0.1520	0.6490	0.4205
VLOWGPA	-1.2625	0.5813	4.7169	0.0299
LOWGPA	-0.5203	0.1460	12.7082	0.0004
FAIRGPA	-0.1844	0.0966	3.6441	0.0563
HIGHGPA	0.2510	0.1406	3.1866	0.0742
VHIGHGPA	0.5621	0.2617	4.6119	0.0318
BUSMAJOR	-0.1130	0.1356	0.6941	0.4048
HUMMAJOR	-0.2968	0.1561	3.6136	0.0573
SOCMAJOR	-0.2588	0.1287	4.0447	0.0443
SCIMAJOR	-0.1626	0.1406	1.3373	0.2475
MATMAJOR	-0.3473	0.1479	5.5150	0.0189
ROTC_LO	-0.4210	0.1420	8.7914	0.0030
ROTC_HI	-0.0993	0.1356	0.5357	0.4642
OCS_LO	0.0617	0.1482	0.1735	0.6770
OCS_HI	0.2304	0.1584	2.1169	0.1457
NESEP	0.2606	0.2305	1.2785	0.2582
YR2SWOQL	0.8554	0.0945	81.8593	0.0001
CGEXP	0.5305	0.1121	22.4118	0.0001
n=3742   -2 Log likelihood=3642.9   Concordant=70.9%   Discordant=28.7%   Tied=0.4%				



**APPENDIX C**  
**(cont.)**

Number (3) Secondary Promotion Model Specification:

Base Model Plus Performance Variables (TOPFIT12/3)

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	1.7744	0.5612	9.9980	0.0016
NONWHT	-0.2043	0.1445	1.9974	0.1576
AGEO1	-0.1262	0.0245	26.4890	0.0001
MARRIEDH	0.3213	0.1072	8.9793	0.0027
VLOWGPA	-1.2651	0.6643	3.6264	0.0569
LOWGPA	-0.5834	0.1603	13.2477	0.0003
FAIRGPA	-0.1136	0.1044	1.1836	0.2766
HIGHGPA	0.1513	0.1523	0.9867	0.3206
VHIGHGPA	0.4703	0.2835	2.7509	0.0972
BUSMAJOR	-0.3672	0.1483	6.1266	0.0133
HUMMAJOR	-0.5661	0.1681	11.3396	0.0008
SOCMAJOR	-0.4389	0.1411	9.6753	0.0019
SCIMAJOR	-0.2439	0.1514	2.5936	0.1073
MATMAJOR	-0.3774	0.1595	5.6001	0.0180
ROTC_LO	-0.4315	0.1541	7.8411	0.0051
ROTC_HI	-0.1840	0.1471	1.5656	0.2109
OCS_LO	0.0714	0.1614	0.1956	0.6583
OCS_HI	0.1246	0.1711	0.5304	0.4664
NESEP	-0.0614	0.2482	0.0613	0.8045
PRENL2YR	-0.0416	0.1645	0.0641	0.8002
TOPFIT12	1.2291	0.0983	156.3620	0.0001
TOPFIT3	1.7598	0.1028	293.3027	0.0001
n=3742   -2 Log likelihood=3148.8   Concordant=80.9%   Discordant=18.8%   Tied=0.2%				

Note: This model is not specifically addressed in the text but is included for comparison.

**APPENDIX C**  
(cont.)

Number (4) Secondary Promotion Model Specification:

Full Model - Includes All variables of Interest

Variable	Coefficient	Std. Error	Chi-Square	Pr>Chi-Square
INTERCEPT	1.1332	0.5795	3.8234	0.0505
NONWHT	-0.1110	0.1472	0.5689	0.4507
AGE01	-0.1233	0.0248	24.7805	0.0001
MARRIEDH	0.2774	0.1082	6.5734	0.0104
PRENL2YR	-0.0537	0.1662	0.1045	0.7464
VLOWGPA	-1.2194	0.6749	3.2646	0.0708
LOWGPA	-0.5480	0.1617	11.4869	0.0007
FAIRGPA	-0.1269	0.1052	1.4540	0.2279
HIGHGPA	0.1258	0.1526	0.6799	0.4096
VHIGHGPA	0.4676	0.2841	2.7087	0.0998
BUSMAJOR	-0.3921	0.1495	6.8782	0.0087
HUMMAJOR	-0.5094	0.1700	8.9786	0.0027
SOCMAJOR	-0.4181	0.1422	8.6404	0.0033
SCIMAJOR	-0.2293	0.1523	2.2675	0.1321
MATMAJOR	-0.3815	0.1606	5.6463	0.0175
ROTC_LO	-0.3870	0.1554	6.2052	0.0127
ROTC_HI	-0.1303	0.1484	0.7699	0.3802
OCS_LO	0.0866	0.1623	0.2844	0.5938
OCS_HI	0.1352	0.1718	0.6196	0.4312
NESEP	-0.0183	0.2507	0.0053	0.9418
TOPFIT12	1.1477	0.1018	127.1285	0.0001
TOPFIT3	1.7348	0.1036	280.4410	0.0001
CGEXP	0.5932	0.1230	23.2730	0.0001
YR2SWOQL	0.3893	0.1060	13.4819	0.0002
n=3742   -2 Log likelihood=3110.4   Concordant=81.6%   Discordant=18.2%   Tied=0.2%				

## APPENDIX D

### Frequencies and Percentages by Race/Ethnicity

Variable	WHITE		NON-WHITE	
	Frequency	Percentage	Frequency	Percentage
VLOWGPA	21	0.33	2	0.33
LOWGPA	467	7.26	108	17.79
FAIRGPA	2020	31.41	265	43.66
GOODGPA	2731	42.47	199	32.78
HIGHGPA	896	13.93	29	4.78
VHIGHGPA	296	4.60	4	0.66
ENGMAJOR	1576	25.19	125	21.51
BUSMAJOR	1090	17.42	126	21.69
HUMMAJOR	762	12.18	59	10.15
SOCMAJOR	1251	20.00	105	18.07
SCIMAJOR	995	15.90	84	14.46
MATMAJOR	582	9.30	82	14.11
USNA	1655	25.73	212	34.93
NROTC	1838	28.85	130	21.42
OCS	2709	42.12	248	40.86
NESEP	229	3.56	17	2.80
PRENL2YR	935	14.54	119	19.60
CGEXP	4955	77.05	418	68.86
YR2SWOQL	1980	30.79	135	22.24
MARRIEDL	2900	45.09	297	48.93
MARRIEDH	2660	78.12	275	81.60
TOPFIT12	3384	52.62	261	43.00
TOPFIT3	2809	43.68	222	36.57
LCSTAY	3405	52.95	337	55.52
PROMO4	2669	78.38	220	65.28

Frequencies and percentages based on 7038 observations - except PROMO4 and MARRIEDH based on 3742 observations, and MAJOR based on 6837.



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